

# Commissioning: Making it Work For You

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# What is Commissioning

- ASHRAE Guideline 1-1996.
- The **PROCESS** of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the design intent... it begins with planning and includes design, construction, start-up, acceptance and training, and can be applied throughout the life of the building.

# What is Commissioning

- The Department of Energy
- “Building Commissioning involves the **DOCUMENTING** the owner’s goals and needs for a facility and then ensuring that those goals are met.”

# Why We Need Commissioning

- Owner Satisfaction is Down
  - 50% of Buildings Suffer Control Problems
  - 40% Suffer HVAC Problems
  - 85% of Claims Involve HVAC Systems
  - 15% Have Missing Equipment

# What Commissioning Achieves

- Energy Savings of 20 to 50 Percent
- Maintenance Savings of 15 to 35 Percent
- Reduction of Claims 2 to 10 Percent
- Reduction of Trouble Shooting Costs

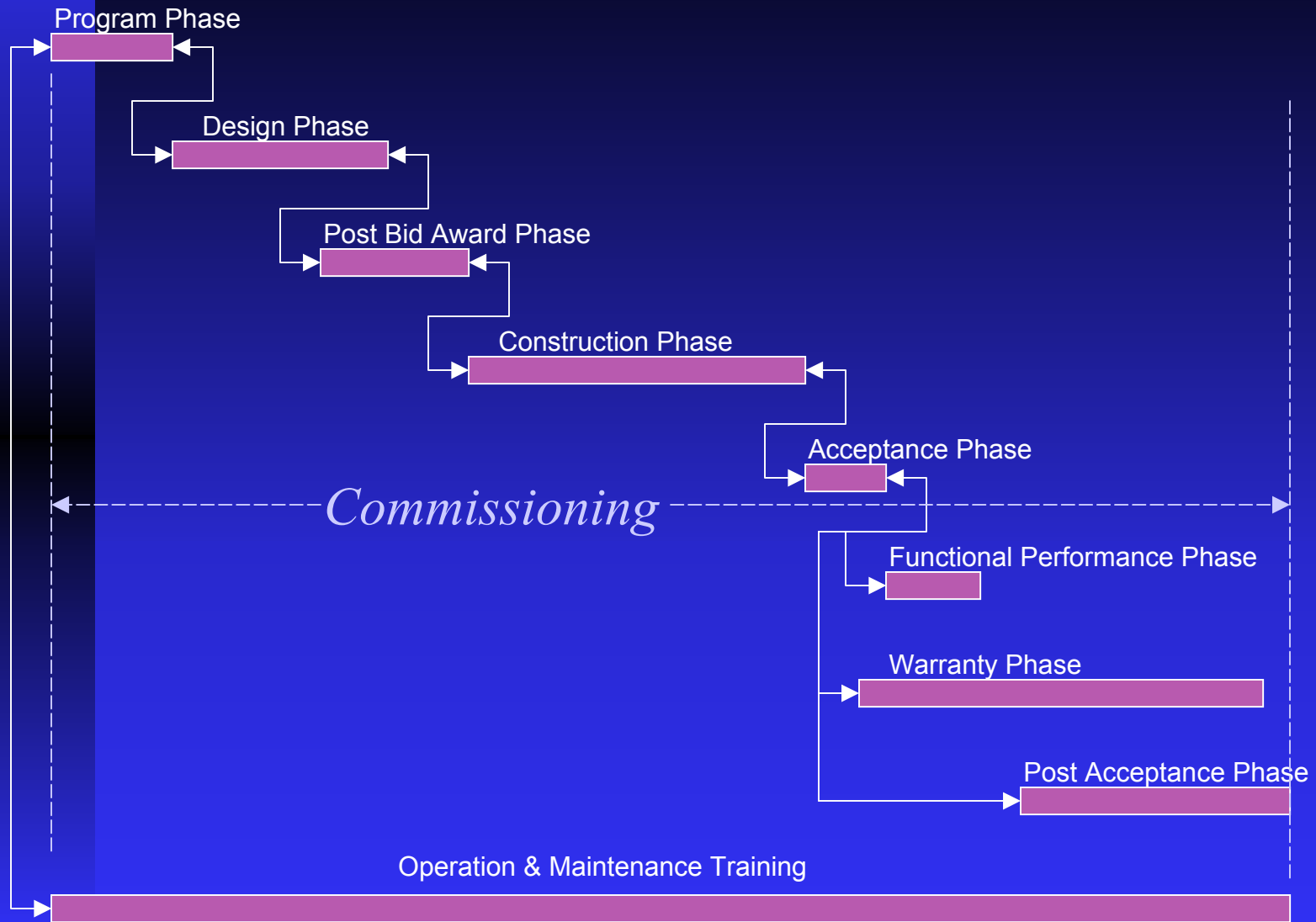
*Source: Building Owners and Managers Association (BOMA) cost data for Office Buildings.*

Oregon Dept of Energy: between \$0.11/SF/yr and \$0.35/SF/yr.

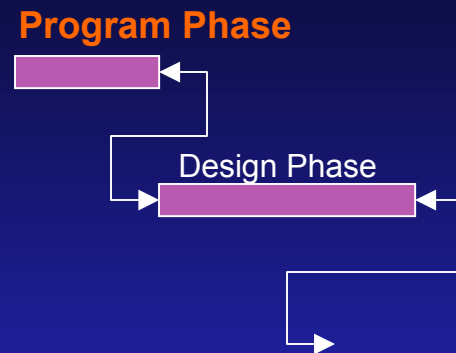
# The Cost of Commissioning

- 0.5-1.5% of total construction costs
- 1.5-2.5% of mechanical system costs.
- 1.0-1.5% of electrical system costs.
- \$0.23-\$0.28/SF

# The Commissioning Process



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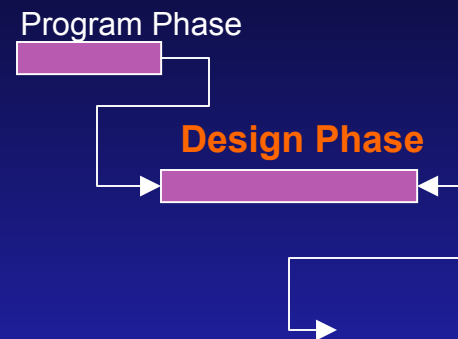


## Program Phase

- Develop Commissioning Team
- Document Design Intent



# The Commissioning Process



## Design Phase

- Develop Commissioning Schedule
- Develop Commissioning Specification
- Plan Review Comments

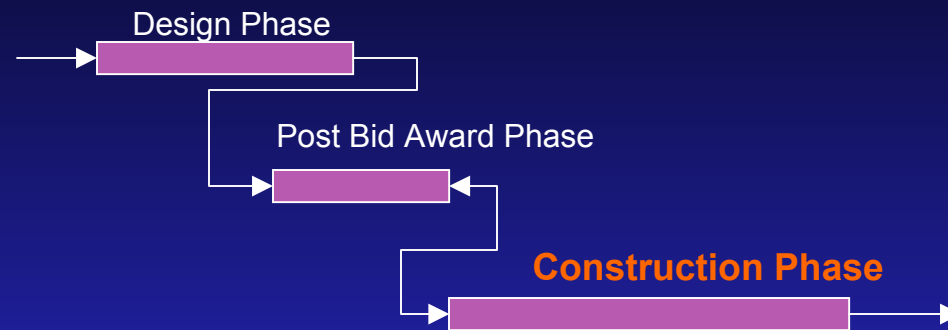
# The Commissioning Process



## Post Award Phase

- Commissioning Plan, Expanded to be job specific.
- Submittal Review
- Develop a Commissioning Schedule (by entire construction team)
- Set up Deficiency Reporting Procedures

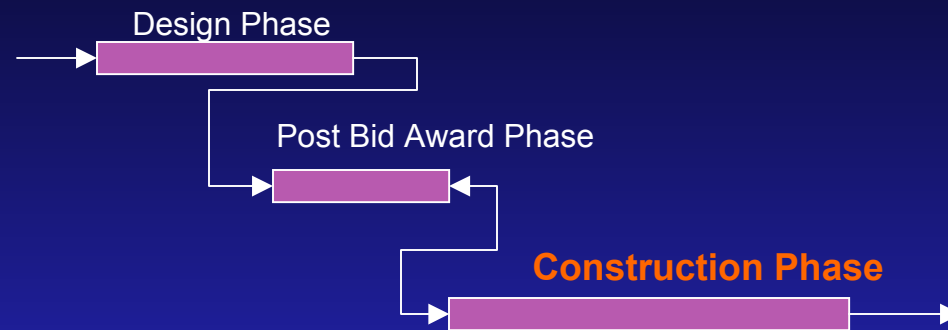
# The Commissioning Process



## Construction Phase

- Coordination Documentation
- Installation Observation
- Static Testing; DALT, Piping Pressure Tests, Ground Tests
- Document Changes

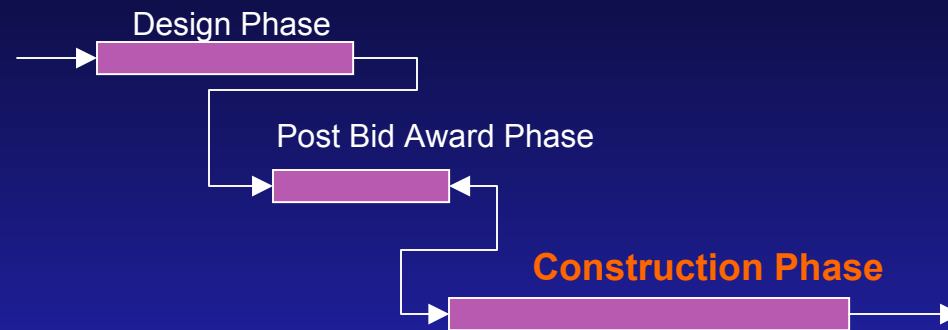
# The Commissioning Process



## Construction Phase

- Start Up Observation and Inspection
- Building Automation Testing: “Point to Point Verification”.
- Testing Adjusting and Balancing Review

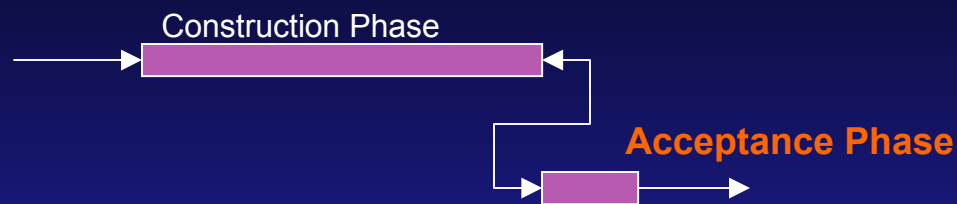
# The Commissioning Process



## Construction Phase

- Deficiency Reporting
- As Built Documents
- O&M Manuals
- TAB Reports

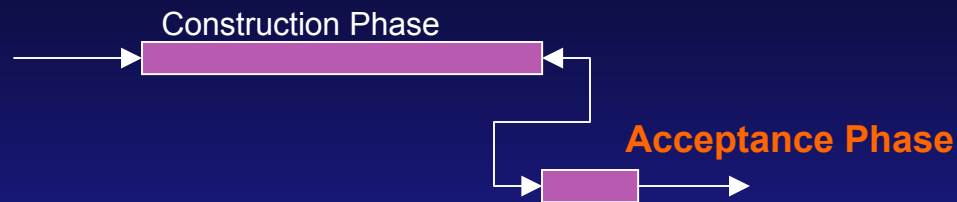
# The Commissioning Process



## Acceptance Phase

- Point to Point Testing
- TAB Accuracy Verification
- Control System Function
- Intersystem Functions

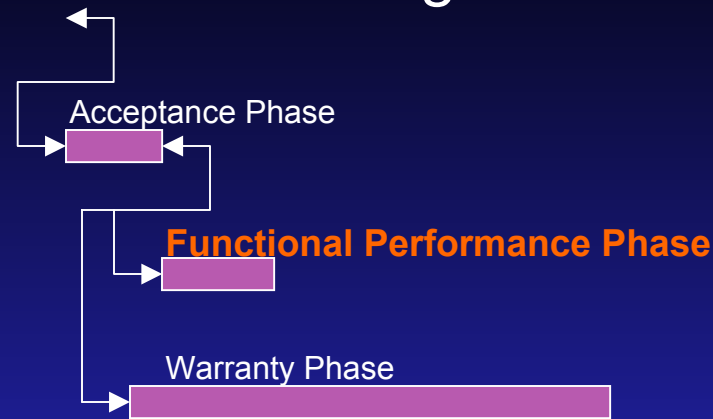
# The Commissioning Process



## Acceptance Phase

- Deficiency Reporting and Corrections
- Verification Report
- Final Test Reports
- Final Deficiency List
- Certificate of Readiness to Begin Functional Testing

# The Commissioning Process

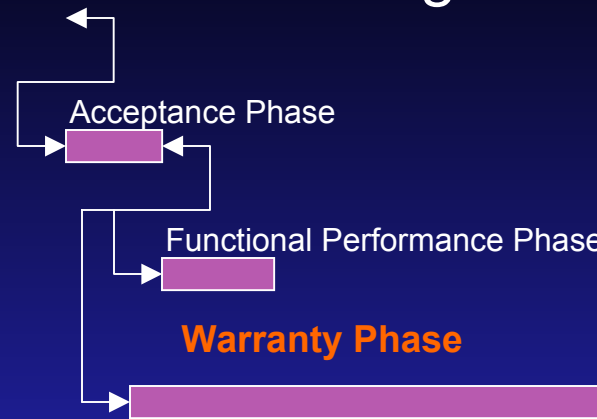


## Functional Performance Phase

- The ability of the system to produce the effect in accordance with the final design intent.
- “The Functional Performance Tests are the heart of the Commissioning process, but they are also the most difficult and time consuming.”



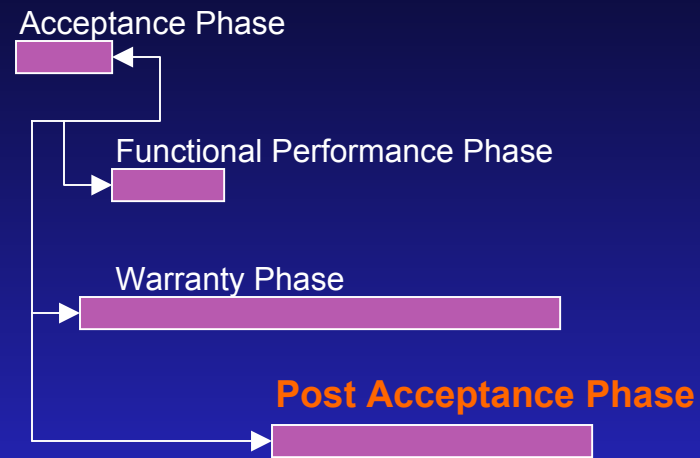
# The Commissioning Process



## Warranty Phase

- Owner's Maintenance Staff Documentation of 11 Month Operations.
- Off Season TAB Testing

# The Commissioning Process



## Post Acceptance Phase

- Final Commissioning Report.
- Prepare Re-commissioning Plan

# The Commissioning Process

## Operation & Maintenance Training



## Operation & Maintenance Training

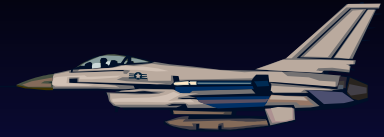
- Done throughout the entire Commissioning Process.
- Integrated and Coordinated with the Contractor's Specified Training Requirements.
- Work with Maintenance Personnel to Develop Maintenance Programs

# War Stories



- War stories tell the Cx tale best
- One of the most important abilities of a CxA is conflict resolution
- It doesn't matter what your technical skill level is, if you can't communicate and get along with others on the project you will never forge a union to focus on the important project goals





# What Cx is Up Against

## ■ Scenario

- ◆ Large showcase project for a large and prestigious client
- ◆ Project delivery is CM with Multiple Prime Contracts, including Mechanical
- ◆ CxA works directly for Owner
- ◆ Mechanical Contractor has worked on many projects for the Owner

# What Cx is Up Against

- We made a checklist of specification requirements including O&M Manuals and Training
- Mech. Contractor submits an O&M Manual that is FAR from meeting the specifications
- We review Manual and recommend rejection and give specific sections of specifications not met
- Engineer agrees with our findings and rejects O&M Manuals
- No word back from Mech. Contractor for sometime – we could not get an answer in Cx Meetings

# What Cx is Up Against

- Find out that Mech. Contractor has made an appeal to the Owner that his O&M Manuals should be accepted and that he should not be held responsible or meeting specification requirements for O&M Manuals or Training
- The reason? They have never been required to meet the specification requirements on this before and that they are delivering the same quality of manual the Owner has always accepted in the past. Furthermore, they bid the project based upon “local prevailing practices”.
- The fact is, no one had been requiring the enforcement of the specifications and yet the Owner complains they have not been getting good O&M information or training – and they haven’t!

# What Cx is Up Against

- This dispute climbed the ladder of the Owner's facility department – everyone was aware that this was a watershed decision by the Owner and would set the course for future projects.
- The Owner decided that the specifications would be enforced and the contractor was obligated – by the contract he signed – to meet the requirements of the specifications.
- If this had not turned out this way, the effectiveness of any future commissioning efforts would be limited at best.



# What Cx is Up Against

- The CxA should not only represent the Owner, he should represent the best long term interests of the O&M staff.
- The first cost of most buildings only represents 20% of the building's life cycle costs. The other 80% is from operation and maintenance costs. It only makes sense that we need to pay a lot of attention to the 80% as well as the 20%.
- Effective commissioning can only occur if the CxA has the unwavering support of the Owner. The Owner is the only one who cares about the 80%.

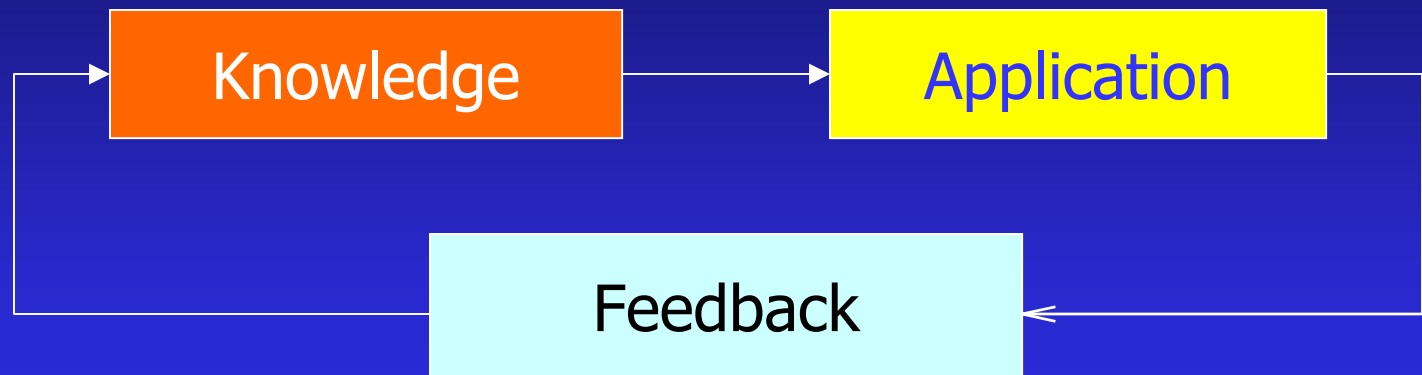
# Components of Cx Process

- A good Cx process should include the following elements
  - ◆ Know what the Owner needs and expects from the building
  - ◆ Represent the Owner's long term interests to help assure a building that meets his functional requirements and can be operated and maintained successfully
  - ◆ Be sure the O&M staff has the right training and tools
  - ◆ Continue involvement in building, where possible, to make benefits persistent

# Little Things Can Mean a Lot

- The most important asset a Cx firm can have, other than good people, is a large database of “lessons learned”. These are mistakes/problems/issues that others have paid for. The CxA should bring this asset to every project.
- The earlier you can prevent or catch a problem, the less it costs to correct. Problems caught in design phase are inexpensive to correct.
- The earlier a CxA becomes involved in a project, the more value it has to the project.
- For the benefits to occur, someone has to listen to the CxA and the CxA needs to explain why a recommendation is important.

# Understanding



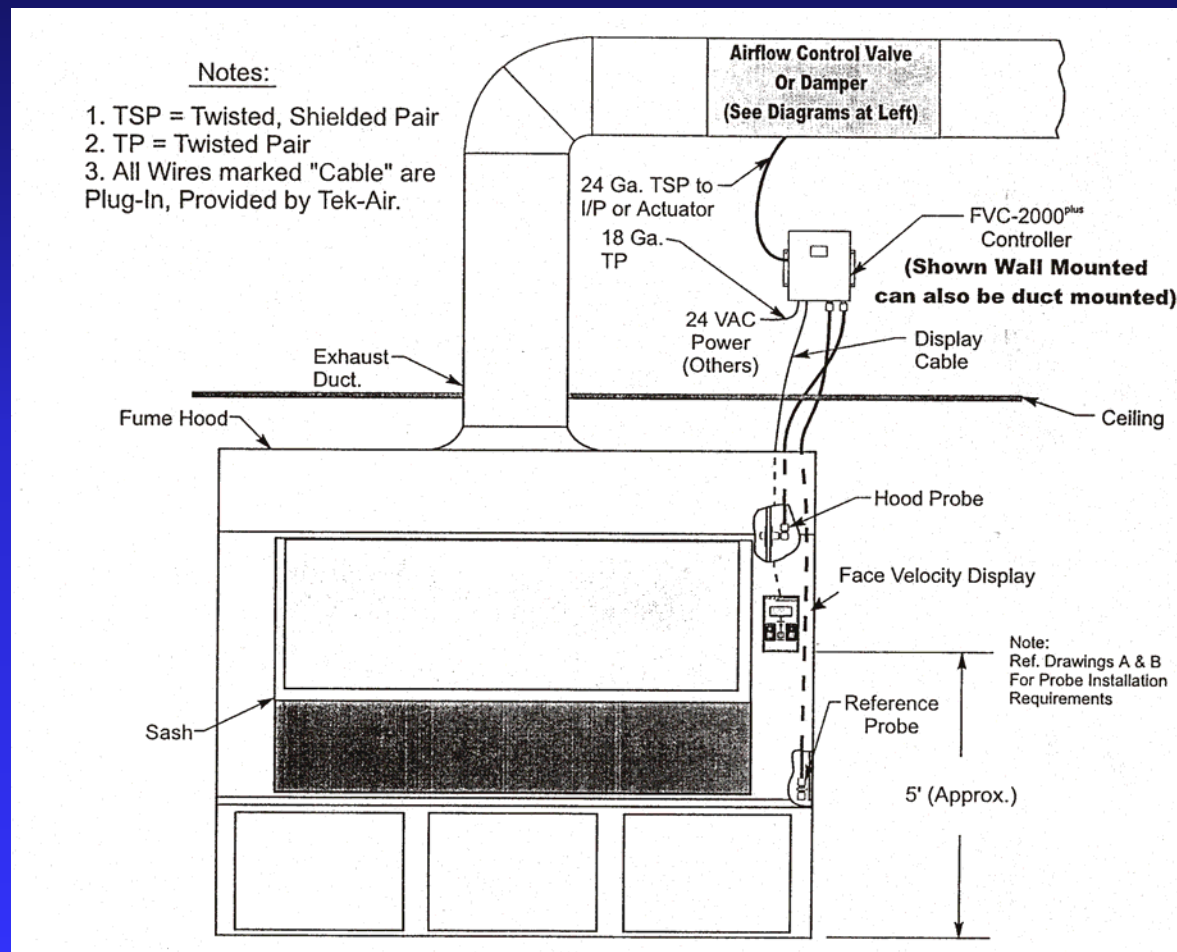
# Little Things Can Mean a Lot

- Triple Duty Valves vs. Shutoff, Check Valve and Flow Measurement device
  - ◆ For TDVs to be able to work as a means to measure hydronic flow, they must be properly sized
  - ◆ Contractors find it least expensive to install line sized valves
  - ◆ The shutoff valve frequently requires a tool to open/close/adjust
  - ◆ TDVs are expensive
  - ◆ Flow measurement devices, such as a venturi, allow excellent flow measurement performance
  - ◆ You don't want to balance flow at pumps by imposing additional pressure resistance

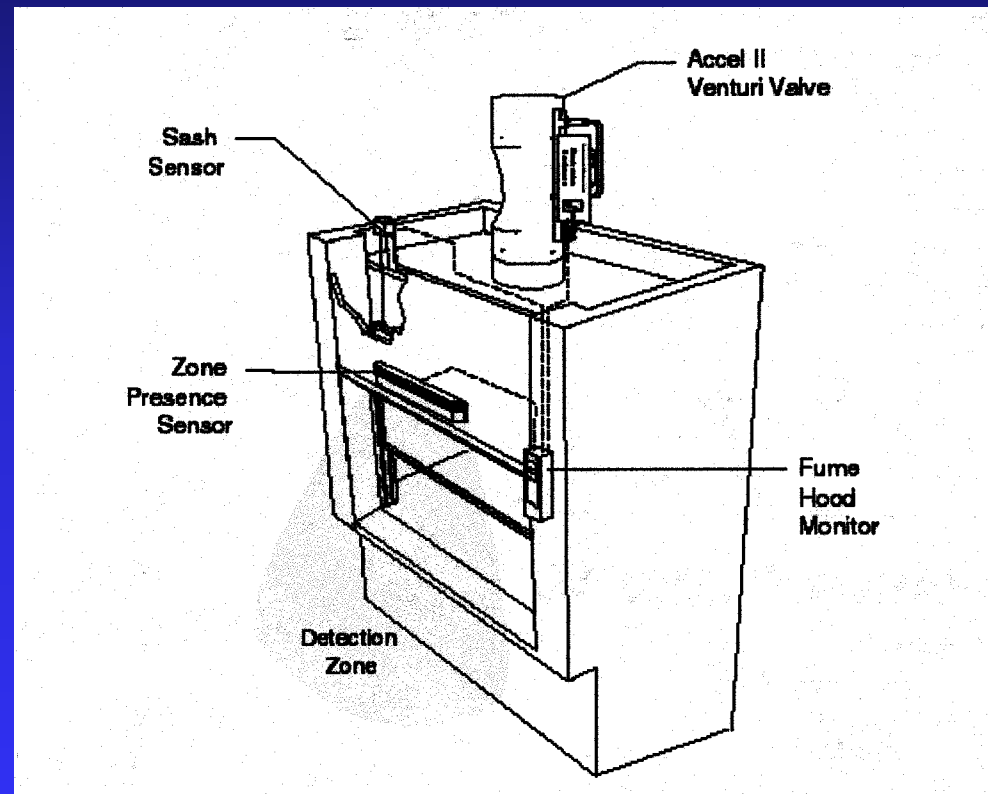
# Little Things Can Mean a Lot

- We flagged this problem in design review
  - ◆ The Engineer changed the details on the plans to call for separate components
  - ◆ The Mech. Contractor was very late in submitting on this. When submittal was made, the Mech. Contractor argued that the Owner's design standards allowed TDVs and that they needed to use them due to a time restriction. The Engineer approved the submittal.
  - ◆ We saw the submittal and flagged this as an issue. We pointed out that if they were going to accept the TDVs they at least needed to require proper sizing
  - ◆ About 6 weeks later we visited the job site and found TDVs on the floor – line sized and not anywhere close to time it would be installed
  - ◆ We pointed this out to the Engineer and asked for him to look up the pressure drop of valves – they were only about 20% of the minimum required pressure drop required to read flow
  - ◆ Still – no one required the contractor to make a change
  - ◆ Later, TAB Contractor (who had backed Mech. Contractor on TDV sizing) stated that they could not read system gpm

# VAV Lab Hood Controls

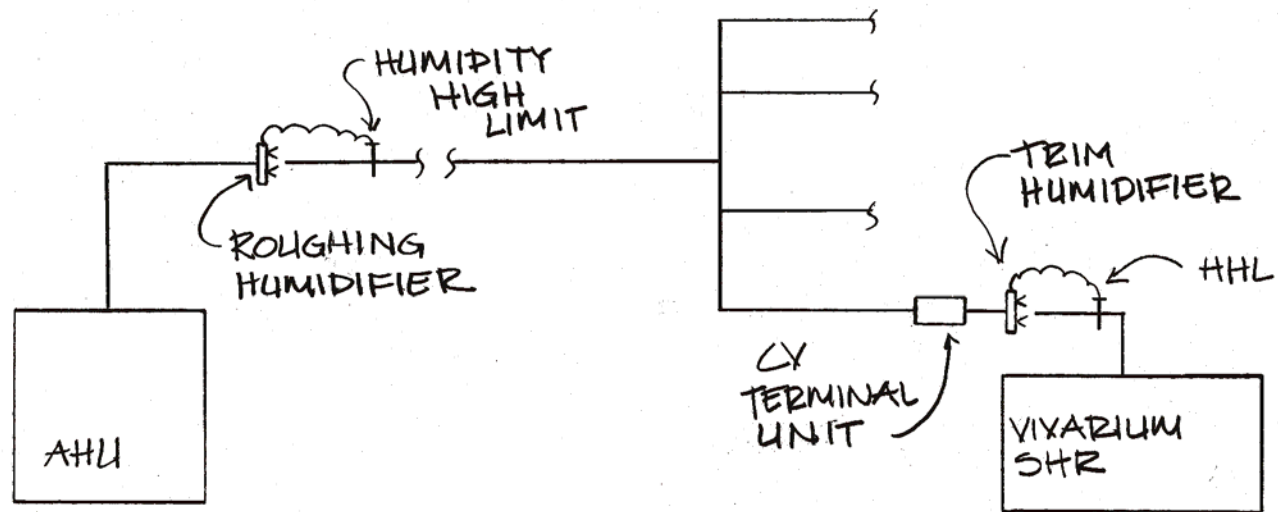


# VAV Lab Hood Controls





# Humidifier Controls



# Cx as a Scheduling Aid

- Mechanical schedule on a large project
  - ◆ 1<sup>st</sup> Floor Mech Rough-In by XX/XX/XX
  - ◆ 1<sup>st</sup> Floor Mech Completion by YY/YY/YY
  - ◆ Same for other floors
- CxA can help keep project on schedule by backwards scheduling with specific milestone dates for specific tasks and by pre-planning with CM/GC system testing sequence
- The milestone dates give an early warning alarm when the building mechanical systems are falling behind schedule
- When contractors have to flood project near completion the contractor's efficiency is reduced and quality control problems increase

# ASHRAE Guideline 0



- Will define the commissioning process for all disciplines under NIBS Total Building Cx Standard
- ASHRAE Guideline 1 will be the HVAC Cx Standard
- Even though these are described as Guidelines, Court cases have already defined them as level of due diligence
- NIBS Standard will include Electrical, Plumbing, Fire Protection, Building Envelope, Roofing, etc
- ASHRAE Guideline 0 has just completed second, and final, public draft review
- We believe that this will be the prevailing commissioning standard
- BCA Cx Certification (CCP) based on Guideline 0 and AEE will probably change from PECEI to this standard for their certification program (CBCP)

# ASHRAE Guideline 0

- Stresses importance of Owner hiring CxA very early in the process
- CxA to document Owner's Project Requirements (OPR) early – even before hiring the Design Team
- The Basis of Design is the design team's response to the OPR
- OPR + BoD = Design Intent
- Greater focus on O&M issues during design
- Pre-functional Checklists become Construction Checklists
- Acceptable means of sampling is defined
- Required Commissioning documentation requirements is better defined

# LEED™ Certification Programs

- LEED NC (2.2 coming)
- LEED EB
- LEED CS
- LEED CI
- LEED AGL
- LEED H



# Wise Old Sayings

- If you keep doing what you've been doing then you're going to keep getting what you've been getting.

# Summary

- Commissioning is a process that can provide substantial benefits to the functionality and long term operation and maintenance of a facility
- Commissioning should be incorporated as early in the process as possible
- Learn the lessons from past problem projects and change what you've been doing so you can change what you've been getting

# Summary



- There is always resistance to change
- Only building owners can drive a change to industry practices and prevent building by “local prevailing practices”
- The commissioning process can help everyone involved in the building design and construction process